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The ILLUMINATING ENGINEER

ELECTRICITY · ACETYLENE · OIL · GAS

Edited by

LEON GASTER

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THE JOURNAL OF SCIENTIFIC ILLUMINATION.

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Illuminating Engineering Society.

(Founded in London 1909.)

Among other articles this number contains :—

A Year's Progress in Illuminating Engineering **(summary of the Report on Progress issued by the Illuminating Engineering Society in the United States).**

The Testing and Characteristics of Searchlights.

Other matters dealt with include :—

FLOOD-LIGHTING AS A PROTECTION FOR OILFIELDS—STANDARD RATING FOR ELECTRIC INCANDESCENT LAMPS—WAR LIGHTING—ARTIFICIAL DAYLIGHT, &c.

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EDITORIAL.

Progress in Illumination in the United States.

In this issue (pp. 285—289) we present a summary of the very valuable account of progress in illumination, compiled annually by the Committee on Progress of the American Illuminating Engineering Society, and presented for the Convention (conducted by correspondence owing to the war) in September last.

It is natural to find that the developments during the last year have been in the direction of steady progress and new applications of light, rather than the evolution of new types of lamps and fixtures. The entry of the United States into the war has naturally led manufacturers to concentrate their attention on increase in output of standardised articles, and many promising lines of investigation have doubtless been deferred

for the present in all the belligerent countries. After the war many interesting developments may be brought to light.

As indicative of the tendency towards standardisation, it is worthy of notice that the voltages of electric incandescent lamps are now being confined to well-defined limits, and that in the gas industry a movement is in progress for a systematic rating of gas lamps, on lines comparable with those adopted in defining the candlepower of electric units.

Perhaps the most striking field of work during the last year has been the greatly extended use of flood-lighting, largely for protective purposes. The method can, however, be applied in many different ways, and it was recently estimated that 97 different uses of flood-lighting had been evolved.

In many directions the illuminating engineering movement has been making itself felt, for example, in connection with legislation on motor-car headlights, and on industrial illumination. The Codes on Factory Lighting in the States of Pennsylvania and New Jersey have been in operation for a year, and have been found satisfactory in nearly all respects. The Wisconsin Industrial Commission has formed a committee to revise its legislation dating back to 1913, and the United States Public Health Service is acting in co-operation with this committee with a view to promoting better lighting in factories. The Ohio Industrial Commission is also arranging for the drafting of a code on factory lighting, so that the recognition of the importance of the subject on the part of the authorities is evidently growing.

When one surveys this record of progress one is struck by the wideness of the ground covered. In connection with photometry the integrating globe has been the subject of special study, and appears to be developing into a practical apparatus for commercial tests. Work has also been done on various kinds of photo-sensitive cells, and there seems a prospect that this form of physical photometry may have special applications in determining the brightness of stars, in researches on the relation of light to plant growth, and in other special fields. There have also been attempts to develop illumination photometers of a simpler type, two of which are based on the limit-gauge principle, originally suggested by Mr. A. P. Trotter.

In connection with interior lighting, we note a steady tendency towards the use of more scientific methods, notably the use of concealed lighting effects in theatres, cinema halls, and other rooms where avoidance of glare is a very essential factor. Street-lighting in the United States seems to have been so far following a normal course, but the special measures taken in this country to reduce the lighting to meet war conditions have been closely studied, and the discussions on this subject before our own Society are reported in some detail.

Many other corners of the field of illuminating engineering are explored, *e.g.*, the researches made in this country on radioactive luminescent paint, and other phosphorescent and fluorescent effects, the emission of light by certain self-luminous insects, and the work of the United States Weather Bureau in defining " civil " and " astronomical " twilight. A point of some interest, to those concerned with fuel economy, is the diminution in the value of daylight illumination through smoke in industrial cities. In some cases, a diminution of 30—40 per cent. on clear days has been noted.

The impression one gathers is that the stream of research in connection with illumination, though interrupted here and there, is still flowing strongly, finding new channels when progress in accustomed directions is denied.

The Metric System.

Since the outbreak of war the supporters of the metric system have not failed to appreciate the opportunity provided for raising the question of a change in coinage, weights and measures to the metric system. The general disturbance of trade values, inconvenient in other respects, would, it is suggested, make the period of transition from one system to the other easier than in normal times, and there is also the favourable circumstance that men serving with the Forces on the Continent will have had an opportunity to become familiar with the metric units.

While the matter is receiving special attention at the present time, the subject has of course often been debated. From a chronological statement recently published in the *Electrical Review*, it appears that the substitution of a "pound and mil" system of coinage was proposed in a discussion in the House of Commons in 1824, while in 1841, after the destruction of the Houses of Parliament by fire, the Commission on the Restoration of Weights and Measures reported in favour of the decimal system. More recently, in 1907, the House rejected, by the narrow majority of 32, a Bill for the compulsory introduction of the metric system, and the Australian House of Representatives, three years later, resolved to adopt the metric system as soon as it became compulsory in Great Britain.

The whole subject has been ably presented in two recent papers before the Institution of Electrical Engineers by Mr. A. J. Stubbs and Mr. L. B. Atkinson. As a matter of principle the simplicity of the metric system, especially the statement of weights directly in terms of volumes and specific gravity, has much to recommend it. In scientific work it is almost exclusively used, and it has already been adopted in many fields of engineering work.

Suggestions have been made that we should avoid some of the difficulties of the change by retaining most of our primary units but adopting a special duo-decimal system of subdivision. We do not think, however, that the adoption of such a system is likely to command general support. If the change is to be made it would seem preferable to adapt ourselves once and for all to the measures prevalent throughout the rest of the civilised world. In the future, when trade relations with foreign countries will occupy a large share in public attention, the advantages of adopting a system corresponding as closely as possible to that in use abroad will no doubt carry great weight.

The chief objection commonly urged against the change is the large amount of disturbance involved and the loss entailed in scrapping existing weights, measures, and measuring appliances based thereon, and the revision of arrangements of payment based on existing coinage. It should, however, be borne in mind, as Mr. Stubbs points out, that the loss will be distributed throughout the country, and that the sacrifice of each individual, for example, in purchasing a new set of weights, will not in general be heavy. Naturally, measures would be taken to render the transition as easy as possible.

Summing the matter up, one may say that there are many reasons to desire the ultimate adoption of the metric system, but at the same time the magnitude of the change, and the dislocation of existing practice which it would cause, have to be carefully considered. The decision should be based on a comprehensive survey of the industrial field, and in the meantime consideration of the problem by technical societies and industrial bodies can do a great deal to prepare the ground for the future.

The Metric System and Illuminating Engineering.

So far as the lighting industry is concerned, a change to the metric system would not present greater inconvenience than in any other section of industry; in some respects it would probably be less. There would naturally be a period during which the dimensions of lamps, reflectors, etc., were specified both in British units and in the metric equivalent. The ultimate adoption of centimetres and millimetres, and the disappearance of the inconvenient 1/8ths, 1/16ths, and 1/32ths of an inch assigned frequently to galleries, holders, etc., would be a blessing.

In regard to electric lamps, we have already gone some distance towards the metric system and the adoption of Continental measures. We no longer speak of 8, 16, and 32 c.p. lamps, but of 20, 30, 50, 100 watt units, etc. Specific consumption is still expressed in candles per cubic foot per hour, but familiarity with Continental literature would make the transition to litres comparatively easy. Again, in dealing with kilowatts and 1000's of cub. feet of gas, we are already using a decimal system.

In one respect we are certainly favourably situated. We have a unit of candlepower which is likewise accepted by the United States and France, and which is easily convertible into the only other unit of consequence, the Hefner. The Lumen is independent of the unit of length adopted, provided the unit of candlepower is the same. The foot-candle would presumably be replaced ultimately by the lux (metre-candle), but the transition is not difficult, if it is remembered that the lux is approximately one-tenth of the foot-candle.

It is sometimes urged that numerically the foot-candle is a more convenient unit than the lux, in that it represents an amount of illumination which is commonly used and has come to be regarded as a rough standard for general work. On the other hand, there is less force in this contention than there would have been a few years ago. The tendency for some years has been towards higher values, and for many purposes where we should have formerly been content with a foot-candle, we should use more to-day. The older writers, for example, not infrequently specified one foot-candle as sufficient for ordinary reading and writing. To-day this is hardly considered sufficient. The Joint Committee of the Illuminating Engineering Society in 1913 suggested a minimum of two foot-candles for desks in schoolrooms, and for many factory operations five foot-candles or more are now not uncommonly provided.

From this standpoint there is therefore less objection to expressing illumination in lux. This would, in general, avoid the use of decimals, and in street-lighting, where we may go down to 0·01 foot-candle, the multiplication of values by 10 would seem to be an advantage.

On the whole, therefore, the transition to metric values in illuminating engineering would not impose very great difficulties, and owing to the fact that the movement has been essentially international, we are, as a body, more conversant with the metric units than would be the case in many other industries. When the time comes for the conversion from British to metric units to be taken in hand we should be quite prepared to publish values on the old and new basis simultaneously for a time, and in this way prepare the ground for the final alteration.

LEON GASTER.

A YEAR'S PROGRESS IN ILLUMINATING ENGINEERING.

Abstract of Report prepared by the Committee on Progress (consisting of F. E. Cady (Chairman), E. F. Kingsbury, W. B. Lancaster, R. ff. Pierce, and T. W. Rolph) of the Illuminating Engineering Society in the United States, for the Correspondence Convention, September—October, 1917.

IN the introduction to this Report the Committee remark that the past year has been marked by a steady growth in the perfection of methods rather than by striking- developments. Owing to the war there has been little time for the spectacular, and novelties and new developments have been held in abeyance. The effect of the war has been noticeable in connection with the extension of flood-lighting for protective purposes, and in the night-illumination of factories working to fill increased orders.

Gas Lighting.

Among other matters reference is made to recent researches on the early history of gas lighting in New York City, to the development of monazite deposits in Ceylon, and a new gaseous mixture discovered by a Swedish chemist as a substitute for acetylene. This compound is produced by the decomposition of calcium carbide and hydrocarbon oils. The colour of the flame is whitish, and it is said to be applicable for use with incandescent burners.

There have been experiments on new materials for gas production, a French company having tried to use wood for the purpose. At the existing high price of coal the process is said to be practicable.

A self-shaping high candlepower inverted gas mantle stated to be unaffected by dampness or climatic changes and made of special fibre is mentioned.

In co-operation with the Bureau of the American Gas Institute the Bureau of Standards is making an experimental study of the rating of gas lamps, and the influence of pressure. An interesting development in England is the offer of one gas company to supply upright or inverted burners free in place of flat-flame burners. In America there is a similar tendency in this direction. The adoption of a calorific standard for gas is becoming general and the Bureau of Standards is studying the influence of calorific power on various incandescent gas lamps. The New York State Public Service Commission has fixed the calorific standard in the second district of New York at 585 B.Th.U., a monthly average.

Electric Incandescent Lamps.

The sale of carbon filament lamps has not diminished as rapidly as might be expected. The 50-watt tungsten lamp has come into more general use. Manufacturers are concentrating on a standard range of 10, 25, 50, 75, and 100 watt lamps, while a 150-watt gas-filled lamp has been introduced and is a useful intermediary between the 100-watt and 200-watt types. A decided increase in the number of small lighting outfits in homes where no central station supply is available has led to the development of a special line of lamps adapted to a battery of 16 accumulators. The rise in the average candlepower of lamps supplied still continues, being now almost three times what it was ten years ago.

As regards new developments, attempts have been made in Germany to use carbon filaments in an atmosphere of mercury. The drawing of tungsten wire for lamps is being adopted in Japan, and a new German process is mentioned for drawing tungsten wire only a few hundredths of a millimeter thick, and octagonal in cross section. The tungsten is mixed with two per cent. thoria and squirted, being subsequently consolidated at a temperature of 2,400°—2,600° C. The use of crimped ribbon tungsten has been proposed for very high candlepower lamps, as giving a large radiating surface and being less fragile.

As a result of recent research soda appears to be a possible substitute for potash for the making of glass for lamp-bulbs.

Lamps with special blue glass bulbs to imitate daylight are making progress. An interesting application of such lamps is in laundries, where it is found that scorching, giving rise to brownish spots, can be more easily detected by this light.

Arc Lamps.

A number of researches on arc lamp carbons are reported. Many of these deal with the problem of avoiding the formation of insulating slag on electrodes. The addition of borates and other alkali salts has been found helpful in this respect, and boracic acid is stated to be specially good for open-type lamps. With positive carbons containing 30—40 per cent. of luminous salts, 3—5 per cent. of boracic acid is used. The average time needed to trim a lamp in actual service has been found to be 1 minute 40 seconds. It has been found impossible for a man to trim more than 100 lamps in one day.

The arc lamp has found an interesting application for the practical manufacture of chemicals. Experiments, for example, have shown that the white flame arc lamp can be used to accelerate the chlorination of natural gas in the production of chloroform.

Vapour Lamps.

Two new types of mercury vapour lamps, one for alternating, the other for direct current, and operating at 200 volts are announced. They are intended for use in situations where low head-room is desirable.

Various experimental lamps due to Prof. Nernst are mentioned. One of these depends on an arc between carbon electrodes in a mercury atmosphere, the efficiency being similar to that obtained with mercury lamps. The other lamp has for its principle the addition of salts which fuse at the temperature of mercury vapour. This lamp is stated to yield 3,000 candles (Hefner) on 120 volts at 4 amps., thus working at 0·16 watt per Hefner.

It has been found that by making the positive electrode of a mercury lamp of thallium or caesium its efficiency as a source of ultraviolet light is much increased.

Projection Lamps.

Many small portable moving picture projection outfits have been put upon the market, both for private use and for the use of salesmen desiring to exhibit moving machinery in operation. Incandescent tungsten lamps with concentrated filaments are used for this work. Another development has been the demand for pocket flashlight lamps; a lamp of this kind for trainmen, having a red bulb one end and a clear bulb at the other, has been introduced.

A brief description is given of the most recent type of searchlight with cooled electrodes, which has been already dealt with in this journal.

The tendencies in automobile head-lights are also shortly summarised. The Interstate Commerce Commission has investigated the carrying power of locomotive headlamps. A standard 250-watt 32-volt lamp with an 18 in. by 9 in. reflector, was employed. At a speed of 20 miles small objects on the line could be distinguished at a distance of 800 ft., and at 1,000 ft. with the locomotive at rest. Researches have also been made on the yellow glass used in signal lanterns, with a view to getting the best colouration and minimum absorption. It is proposed to eliminate white lights from signalling arrangements owing to the increasing use of such lamps for other purposes.

A light-signalling apparatus for ships at sea has been devised to prevent collisions between vessels in fog. It is based on the fact that in general the fog or mist is less thick near the surface of the water. Accordingly, lamps and observers are stationed as low down as possible.

In regard to miners' lamps the tendency is towards heavier and more substantial types. A nine-hour acetylene lamp has been recently introduced. The Bureau of Mines has recently approved an electric unit having a ½-candle incandescent lamp with a life of 300 hours. It weighs only 4 oz.

Effects of the War.

The matter in this section covers familiar ground, frequent reference being

made to discussions before the Illuminating Engineering Society in London in regard to street-lighting, the effect of public illumination on the frequency of accidents, etc. Tests at the National Physical Laboratory have shown that on a dark night the light of an ordinary match may be distinguishable at a distance of one mile, which forms some justification for the prohibition of lighted matches, cigarettes, etc., on the fronts of important coast towns.

Considerable attention is devoted to the protective uses of flood-lighting. A list of 97 different applications for such lamps has recently been prepared. For the illumination of specified objects 2—10 foot-candles, and a watt consumption of 0·2—5 watts, according to the conditions, are required. An account of recent installations for the lighting of public buildings, and for the guarding of important bridges, factories, etc., is given. An interesting development is the application of this method to the illumination of air-break switches, lightning arrestor-gaps, etc., on high-tension installations, where the large distance apart of poles renders impracticable ordinary methods of lighting. Flood-lighting has been used for the production of ornamental effects in parks and gardens, and, on a small scale, it has been suggested as having a useful application to the cultivation of allotments, enabling work to be done at night.

Flood-lighting with gas is also coming into use. In some instances ordinary curb-posts have been used to carry projectors.

Exterior Lighting.

In the Street-lighting Section the developments in lighting of a large number of American cities are summarised.

Several examples of special exterior illumination are given, a novel device being the mounting of diffusing glass panels, carrying lamps behind them, in the face of buildings. In one case the glass insets were arranged to give the effect of marble-veining in the daytime.

The American Association of Agricultural Engineers has recommended standard rating and specifications for farm-lighting equipment, and this has been the subject of study by a representative of the Chilean Navy. In sign-lighting the tendency is towards the use of transparencies, in view of their artistic possibilities and freedom from glare.

Interior Lighting.

The Health Department of the City of New York has undertaken a sanitary survey of a trial block in order to ascertain the conditions under which operators work in various parts of the city. Enormous variations in the amount of light used are noted, and over 85 per cent. of the rooms visited were found to require artificial light in daylight hours. Ceiling lights are rarely sufficiently powerful, and therefore local lights giving 8—9 foot-candles are recommended for desks, typewriters, &c.

A block of shops in New York City has also been equipped with model lighting to serve as a demonstration. A novel decorative system attempted in one building is the combination of indirect sources giving light of different colours so as to produce pleasing colour-effects on the ceiling, but to yield a general illumination which is practically "white."

The Public Health Service has been making a study of the lighting of steel plants and its effect on the eyes of workmen. In the lighting of auditoriums and theatres the tendency is towards concealed sources. The use of blue-bulb tungsten lamps for Art Galleries is increasing.

Glassware and Fixtures.

Various new developments of prismatic glassware are mentioned, for example a diffusing unit made up of an upper reflector and a lower glass distributor provided with concentric corrugations, which are frosted at the crest or apex and transparent on the other side. Another indoor reflector has a body and shield of pure white enamel and between them a prismatic band for the transmission of light rays reflected from the top. Yet another unit consists of two parts, of which the indirect reflector is made of porcelain-enamelled steel, while at the bottom is a glass diffusing plate made in one piece with an envelope of moulded glass, easily detachable.

A new industrial unit, specially intended to eliminate glare, is made up of a polished metal cap fitting over the pip of the lamp itself so as to cut off direct radiation, and an inverted pan-shaped porcelain-lined reflector 20 inches in diameter. A novelty of interest in theatres is the adoption of "disappearing footlights."

A detailed survey of the distribution curves of a large number of globes, shades and reflectors has been undertaken by the Petrograd Polytechnic Institute. Tests were also made on the effect of dust and the conclusion was drawn that in an average installation fixtures should be cleaned thoroughly once a month, and dusted once between cleaning.

Photometry.

Various arrangements of mirrors have been adopted to employ the device of determining mean spherical candlepower of lamps by measurements in zones 36° above and below the horizontal. Special attention has been given to the integrating sphere, and attempts are being made to standardise the method. As a result of 20,000 observations of various kinds of photometric measurements it has been found that the precision obtainable, with a colour match, in the Lummer Brodhun photometer is approximately 0·3 per cent. With a flicker photometer, independent of colour difference, the precision was 0·75 per cent. Two observers, one working in the field of gas lighting and the other in electric lighting, have independently developed portable photometers based on the Trotter "Limit-Gauge" principle.

It has been found that with a proper form of photo-electric cell the deviation from the straight line law connecting current and illumination is very small, and that the cell can be used for many photometric purposes, *e.g.*, in stellar photometry, plant physiology, &c., and for measuring coefficients of reflection and absorbtion.

Luminous Paints and Bacteria, etc.

Experiments made on the testing of luminous paints in this country are summarised.

There is also an account of recent experiments on luminous insects and bacteria of various kinds. One Japanese insect is said to contain enough chemical material to enable an analysis to be made. A study of the production of light by easily oxidisable amino-phenols has shown that only pyrogallol gives off appreciable light, of an intensity closely approaching the production of luminosity by luminous bacteria.

Two specimens of substances which reveal marked influence to light are acicular crystals of bismuth sulphide and granular antimony sulphide; a piece 1 mm. by 10 mm. of the latter, under an applied voltage of 110, showed a resistance in dull sunlight reduced by about 5,000 per cent. from the value in the dark.

Various.

Among other experiments which may be grouped under this heading may be mentioned an attempt by the Bureau of Standards to develop a standard method of specifying the transparency of tracing cloth, based on the reduction of contrast between standard dead black and dead white materials.

Glasses are still being developed for the protection of the eyes from ultra-violet or infra-red energy, and screens have been prepared commercially for transmitting various regions of the spectrum.

The Weather Bureau in the United States has been making a series of measurements on daylight and moonlight, and has found that at the instant of sunrise or sunset the illumination is about 1,650 times as intense as that of the zenithal full moon. "Civil Twilight" and "Astronomical Twilight" have been defined by the Bureau as occurring when the sun is respectively 6° and 18° below the horizon. Results on tests of the effect of smoke in the atmosphere in cities where soft coal is burned in reducing illumination are also published. A diminution of from 30 to 40 per cent. was observed on clear days.

Legislation on Illumination

The factory lighting codes adopted in Pennsylvania and New Jersey have been in operation over a year and have been

found in the main satisfactory. The Wisconsin Industrial Commission has formed a committee to consider redrafting its existing orders of 1913. The United States Public Health Service has been asked to co-operate with this Committee and with the American Illuminating Engineering Society in securing better lighting in factories. The Ohio Industrial Commission has arranged to have a lighting code prepared.

Until a few months ago only seven States had any regulations bearing on automobile headlights. Two others (New York and Ohio) have recently enacted that the reflected beam shall not rise more than 3·5 ft. above the level surface of the road at a distance of 75 ft. Municipal regulations on this subject are many and widely different, and in sixteen States the use of glaring headlamps is restricted by local ordinances in towns and cities.

Finally reference is made to the effect of the Daylight Saving Act in Europe. In France the saving effected is calculated to amount to 1 ton of coal per month per 1,000 inhabitants. The adoption of the measure is being favourably considered in the United States.

ILLUMINATING ENGINEERING PUBLICITY.

A recent paper before the American Illuminating Engineering Society by Mr. G. H. Stickney draws attention to a number of points that occur in connection with the publicity of illuminating engineering, *i.e.*, statements of the performances of lamps and lighting appliances made to the general public.

As a fundamental principle it pays an advertiser to state what is literally true; fortunately deliberate misrepresentation is now rare. Naturally, in advocating the claims of a new lamp or lighting appliance, recourse is often had to comparisons. But this practice needs to be used with care, and, generally speaking, it is advisable for an advertiser to refrain from comparisons between his own product and that of a competitor. His statements are apt in this case to be discounted as prejudiced.

If comparisons are made they should be in terms of units of the same power; it is unfair to compare a high candlepower unit with a much smaller and generally less efficient one in another class.

In many instances the performance of a lamp may be affected by variable conditions of use, *e.g.*, variation in voltage supply, gas pressure, &c. A company will naturally desire to present results under the most favourable conditions; but it is desirable to supplement such statements by education of the public regarding the best way of using the unit advertised.

In regard to illuminating value, the variation of candlepower in different directions needs to be carefully set out; much inconvenience was caused by the prevalence at one time of exaggerated claims for the ordinary arc lamp. From its standpoint statements of output in lumens have a distinct advantage, being less liable to misrepresentation.

Efficiency is no longer the only "talking point." In some cases other factors are now perhaps emphasised unduly; for example makers are apt to put forward lighting appliances as though they, and only they, were "free from glare"; whereas glare can be eliminated in a number of ways.

In regard to colour-values, precision of statement is particularly to be desired. In dealing with the so-called "artificial daylight" incandescent electric lamps with blue bulbs, the limitations as well as the undoubted merits of such appliances should be understood.

Finally the author attaches great importance to photographs of installations taken solely by the artificial light. Here again the limitations of the method must be borne in mind. The effect shown is dependent on the good faith of the photographer; retouching is best avoided, as in general the retoucher does not see the original installation and may therefore convey a wrong impression.

"ARTIFICIAL DAYLIGHT" AS AN AID TO NATURAL ILLUMINATION.

The application of "artificial daylight" units to special purposes where accurate colour-matching is necessary has frequently been noticed. Such units have now distinct possibilities for reinforcing natural illumination for ordinary purposes. People who refer to the diffused uniform effect of daylight do not as a rule recognise the very wide variations that occur in an average room. If the light is derived from windows on one side of a room only the horizontal daylight illumination thirty feet back from the windows may be only 1-30th (or even less) of that at a table immediately in front of them. When the daylight begins to fail it is therefore in these sections of the room that the difficulty in reading is first experienced. In many London offices these remote portions of the room may receive insufficient light even at noon.

The natural course is therefore to supplement the daylight by local artificial lighting. But this is open to the familiar objection that the two qualities of light do not "mix" satisfactorily, so that the transition from daylight to full artificial light is always inconvenient. In cases where the addition of local artificial light, as an adjunct to daylight, is habitually necessary the new gas-filled electric lamps with special "daylight" glass bulbs seem to have advantages. It is stated that the latest lamps of this kind have an efficiency not far removed from that of an ordinary tungsten lamp and their light resembles daylight sufficiently closely to avoid the inconvenient contrast in colour referred to above.

STANDARDISATION OF LAMP-VOLTAGES IN CANADA AND THE UNITED STATES.

In a recent paper before the Philadelphian Section of the Illuminating Engineering Society (U.S.A.) Mr. U. Rasin remarked that in the year 1916 about 60 per cent. of all the lamps used in the United States were rated at 110, 115, and 120 volts, and that the greater number of the remainder were rated between 112 and 125 volts. We understand that the conditions in Canada are very similar so that the above range series of three standard voltages is rapidly becoming general.

Naturally this will be a great advantage to the electric lamp industry. In Great Britain not only have lamps to be provided for voltages varying from 100—130, but for the additional range of 200—260 volts. It would obviously be a great step towards further simplicity if standardisation in Great Britain could be effected so as to limit the pressures to 110, 115, and 120 volts for low-voltage lamps, and 220, 230, and 240 volts in the higher voltages; the numbers in the upper register being exactly twice those in the lower one.

PYROMETRY.

An important series of papers on pyrometers was presented before the Faraday Society on Nov. 7th. Several papers dealt with the properties and applications of instruments of the thermo-electric type, including a contribution by Dr. E. Griffiths and F. H. Schofield on Pyrometer Standardisations. Mr. H. Watkin also presented an interesting paper describing various devices that have been used in the pottery industry to indicate the correct firing temperature, for example, those based on the contraction of a standard clay object under the influence of heat.

CHARACTERISTICS AND TESTING OF SEARCHLIGHTS.*

By Lieut. S. G. Hibben.

Since the outbreak of war considerable advances have been made by American and foreign manufacturers in the development and manufacture of searchlights. The most usual semi-portable type of lamp employed at the present time utilises a 60-in. mirror and stands about 12 ft. high. Motors with distant control are geared to elevate and depress the projector or revolve the barrel about the vertical axis. Hand wheels are also provided for this purpose and to set the electrodes in the proper positions. Such a 60-in. projector, working at 20,000 watts, will yield about 200,000,000 candles.

The sizes of carbons used are indicated in the following table :—

Projector. Diam. of Mirror (inches).	Negative Carbon Diam. in inches.	Positive Carbon Diam. in inches.
18	$\frac{5}{8}$″ solid	$1\frac{3}{16}$″ cored
24	$\frac{3}{4}$″ cored	1″ ,,
30	$\frac{7}{8}$″ ,,	$1\frac{1}{8}$″ ,,
36	1″ ,,	$1\frac{1}{4}$″ ,,
60	$1\frac{3}{8}$″ ,,	$2\frac{3}{8}$″ ,,

The average life of the carbon electrodes used in the 60-in. type of searchlight is about six hours.

It is more important that the generator units should be reliable in action than that they should be highly efficient. They are subject to rough conditions and must not be affected by moisture, rain or abnormal temperatures. A 25 k.w. unit will consume about 6 gallons of gasoline per hour. In a typical 60-in. projector the arc P.D. is about 55 volts and the current nearly 180 amps.

The ratio of diameter of mirror to focal length is practically a straight line function. In the present state of manufacture it is impracticable to make Mangin mirrors of diameters exceeding 60 inches. The focal length must be too short on account of the danger of the heat from the arc cracking the mirror. On the other hand the greater the focal length the smaller the proportion of light that strikes the mirror. The dispersion is least when the ratio of crater-diameter to focal length is a minimum. For a $\frac{3}{4}$ in. diam. crater, a 36-in. mirror and a 15-in. focal length the total spread of the beam is $\frac{3}{4} \div 15$, *i.e.*, about 3 degrees. There will also be some dispersion caused by the front glass. The combined absorbtion of light by the mirror and front glass may be in the neighbourhood of 20 per cent. In normal circumstances, with currents from 160—180 amps., the maximum effective crater candlepower is about 50,000, and the intrinsic brilliancy of the crater is then about 80,000 candles per sq. in.

The temperature of the positive arc crater is from 4,000°—5,000° C., and for high-current densities the carbon holders must be cooled.

Approximate values of beam candlepower can be calculated by the following formula:—*

$$1 = X\frac{(d)^2}{(c)^2}$$

where

1 = intensity of projected beam of light.
X = intensity of light striking mirror (c.p. of arc crater).
d = diameter of mirror in feet.
c = diameter of arc crater in feet.

This formula does not take into account the atmospheric and glassware absorbtion. Applied to a 60 in. projector with an arc crater of 1·1 in. and a crater candlepower of 49,000 this formula gives a maximum beam candlepower of 151,000,000.

* Abstract of an article in the *Electrical World*, September 1st, 1917.

* This formula is equivalent to the general rule: c.p. of beam = area of mirror × intrinsic brilliancy of crater.

A better method of estimating the effective value of a searchlight is to measure the actual illumination received on a target at a specified distance.

The following values for a target at a distance of 2,730 feet, are of interest :—

Current in Arc (amperes.)	Illumination on Target (foot-candles.)
20	0·4
25	0·7
40	0·9
60	1·0
90	1·0

Owing to the fact that there is always a certain amount of atmospheric absorbtion it is usually impracticable to work at a greater range than about 6,000 feet. The ranges at which targets of gray or medium light colours may be satisfactorily illuminated by a 60-in. searchlight are as follows :—

Atmospheric Conditions.	Range in yards.
Very clear atmosphere ..	.. 10,000 or more
Average atmosphere ..	.. 6,000—8,000
Slight haze or rain ..	.. 3,000—4,000
Fog or early dawn ..	.. 1,000—2,000

Cases are, however, known in which vessels have been located at a distance of nine miles, and on slightly foggy nights the beams may be seen in the sky at still greater distances.

In experience it is found that it is best to illuminate as little of the foreground and surroundings as possible in order to minimise glare through reflection and avoid disclosing to the enemy the position of the searchlight. The most favourable direction of the beam of light is found to be 30° with the line of fire.

PROTECTIVE FLOOD-LIGHTING IN THE OILFIELDS.

In the *General Electric Review* another interesting instance of the use of flood-lighting for protective purposes is mentioned, namely, in the oilfields of Oklahoma, where one thousand 55,000-gallon tanks of oil are located. Great damage could be done by fire, and a guard has been installed against any possible hostile action.

In addition flood-lighting equipments have been mounted on the top of special derricks 42 ft. high, at the top of which look-out towers 8 ft. in height are situated. The flood-lighting projector is six feet above the top of this look-out tower and is thus 56 ft. above the ground. The observer in the tower can thus illuminate and survey a very wide area. Similar stations are located throughout the field at intervals of about a mile apart.

THE MINIMUM RADIATION PERCEPTIBLE TO THE EYE.

A contribution on this subject to a recent number of the *Astrophysical Journal* by P. Reeves summarises the work of various observers. These researches are of interest in connection with observations of stellar magnitudes, as well as having a bearing generally on problems in which the location of distant faint lights is involved. Experiments can conveniently be made on an artificial star, produced by means of a small aperture 1 mm. in diameter having behind it a translucent screen illuminated by an artificial source of light and viewed at a distance of 3 metres. The brightness of the aperture could be adjusted by means of decimal neutral filters and wedges.

Naturally the minimum intensity perceptible varies according to the sensitiveness of the eye of the observer, his state of health, the condition of adaptation of the eye, and the pupil-aperture (which apparently fluctuates in the dark between wide limits). Trouble is also experienced from after-images and ideo-retinal light in the eye itself, probably produced by the retinal circulation. Values recorded for the minimum energy necessary to produce a sensation of light were found to vary from $7{\cdot}7 \times 10^{-10}$ to $38{\cdot}0 \times 10^{-10}$ in the case of different observers.

SHORT NOTES ON ILLUMINATING ENGINEERING.

AN OXYGEN-FILLED TUNGSTEN LAMP.

ACCORDING to a recent German patent, beneficial results follow the burning of a tungsten filament in an atmosphere of oxygen at low pressure. This, it is claimed, prevents discharges through chlorine vapours evolved from anti-blackening materials introduced into the bulb. The oxygen at low pressure does not appreciably attack the incandescent tungsten filament, but in the colder regions of the lamp vaporised tungsten is oxidised to tungsten trioxide. The pressure of the oxygen present is, however, extremely low, being less than 0·005 millimetre of mercury.

The small amount of oxygen initially introduced into the lamp would be quickly used up, and the author therefore proposes to include within the bulb certain oxygen-yielding substances, such as the oxides, nitrates, chlorates, &c., of suitable metals. Manganese oxide, in small quantities, is found very beneficial.

CO-OPERATION IN GAS AND ELECTRICITY PRODUCTION.

In his presidential address to the Institution of Gas Engineers, Mr. C. H. Wordingham dealt with the problem, that has come to the fore since the war, of co-operation between gas and electricity undertakings.

"The problems of economy in fuel-use and cheap power production," he said, "are really distinct. While for motive power and lighting, and for certain kinds of furnace work, electricity has a great field of action; there will always be immense opportunities for gas-heating. Gas production should be an intermediary between the raw fuel and the live steam, and so be concerned in the generation of the whole of the electricity used." Mr. Wordingham added that he had for many years advocated the close co-operation, if not the fusion of gas and electric interests, and he believed that appreciation of the soundness of this view was gaining ground.

It is in the national interest to get the maximum useful result in dealing with coal as fuel, and at the same time to extract all the valuable by-products and their derivatives. Here the skill of the chemist and gas engineer come in. The whole of the coal raised should be treated as near to the pit's mouth as practicable, and the useful by-products extracted. At this point the electrical engineer should take up the question of the economical generation and distribution of electricity in bulk.

GAS RATIONING IN HOLLAND.

It appears that Holland, like Denmark, is feeling acutely the present shortage of

coal and the consequent difficulties in the production of gas.

The *Gas World*, quoting from a recent letter in the *Daily Telegraph*, describes the experiences of a consumer in that country who has had to shut down the gas fire in the drawing room, as it exceeds the ration; if this were burned no gas could be used for lighting. Electricity is also rationed, and candles are said to be almost unobtainable. The gas ration for cooking in this case was equivalent to only one cubic foot per day, so that the household has had to practically give up cooking and get its meals from an adjacent emergency kitchen.

OUTSIDE LIGHTING OF CINEMA HALLS BY GAS.

The *Journal of Gaslighting* describes a method of outside lighting by gas which was recently applied by the United Gas Improvement Company to cinematograph frontages in Philadelphia.

The arrangement can be conveniently used with any building equipped with a parapet. Four high-candlepower lamps are spaced at equal distances on hinged brackets supported from the parapet in such manner that they can readily be secured in position in front of the building, or turned round for cleaning or repair. A strong wrought-iron pipe, held firmly by tie-rods, is carried to about three feet above the back of the parapet and a horizontal arm connected by a swing joint carries the lamp. The strain is taken off the hinge, and the lamp locked in position and maintained in place under high wind, by a removable intermediate support that comprises three legs and an adjustable upright, and can be fixed on the parapet. The lighting and extinguishing are both controlled from the manager's office by means of electric current from dry batteries.

The arrangement would be beneficial in enabling powerful lamps to be mounted high up out of the immediate range of vision, and it would, no doubt, be practicable to combine with them a translucent notice in front so as to screen the direct rays, at the same time utilising their light for the purposes of advertisement.

CLASSIFICATION OF ILLUMINATING ENGINEERS FOR WAR SERVICE.

We understand that the Illuminating Engineering Society in the United States, in common with other bodies in that country, is making out a classification of its members with a view to their employment for war work in positions where their special knowledge will be of service.

It is hoped that this step will be useful in assisting the authorities to put the square peg in the square hole.

RESTRICTION OF SIGN LIGHTING IN THE UNITED STATES.

We observed that an Order issued by the United States Government in November prohibits the lighting of outdoor signs and other forms of electrical display until 7.45 p.m. at night. This Order is intended to bring about a saving in coal required for producing electrical energy, and appears to eliminate the use of illuminated signs over the peak period. The total amount of power so used in the States is estimated to be equivalent to the use of 250,000 tons of coal per annum, and it is calculated that the new measure will save 50 per cent. of the power at present employed for electrical display.

This is a moderate restriction, and it is evident that the authorities have designed it to enable a period of adjustment to the new conditions to take place.

THE SEPARATION OF VISIBLE AND INVISIBLE LIGHT.

In the *General Electric Review*, W. S. Andrews describes a simple apparatus for the separation of visible and invisible light. The rays from a small source of light are concentrated by a quartz lens. The focal point for visible rays is then at a different distance from the lens than in the case of visible light. Accordingly, if a pin-hole is placed at the non-visible light focus, the luminous rays will be largely intercepted by the diaphragm.

The apparatus will prove very useful for studying the fluorescence of willemite and similar substances under the light from an iron spark. If some such separator is not used the fluorescence of many materials is apt to be masked by the large percentage of visible light striking the specimen.

THE SHORTAGE OF ELECTRIC LAMPS IN THE UNITED STATES.

Another indication of the effect of the war in the United States is furnished by the reports of a shortage of electric incandescent lamps in certain localities.

According to an inquiry by the *Electrical World*, there is at present no valid reason for such a shortage, unless it is due to transport difficulties. In any case it is anticipated that it will only be temporary.

It is possible, however, that the acute demands for Army cantonments and Navy bases may have produced an apparent shortage in the 25, 40, 50 and 60-watt types.

In one direction, automobile lamps, there is an admitted shortage chiefly owing to the abnormal increase in the demand.

COAL SHORTAGE AND ITS EFFECT ON U.S.A. GAS PRODUCTION.

We notice that increased demands for gas production, coupled with difficulties in getting sufficient coal, are now causing inconvenience to gas companies in the States. In that country, as in England, new demands for gas in war industries have sprung up. In some cases the effect of scarcity of coal on the householder has also been the cause of trouble. The Indianopolis Company, for example, finds that many consumers are using gas instead of coal for house heating, and in some cases have even used the gas-range for heating purposes.

Evidently there, as here, the situation calls for economy on the part of the consumer, and the avoidance of all wasteful methods of using gas, either for heating, cooking, or lighting.

CARBONS FOR CINEMATOGRAPH WORK.

According to a recent patent (No. 1,241,740) taken out in the United States, the correct proportions between diameters of positive and negative electrodes has an important influence on the steadiness of arcs used for cinematograph work. The patent states that by using a ratio of 4:1, and by an improvement in the copper-plating of the negative carbon holder, all flickering and sputtering can be avoided. With a single copper covering beads of molten copper are apt to form in the crater, causing undesirable flicker, and sometimes leading to the projection of copper particles on to the lens. It is claimed that this effect can be eliminated completely by using a second coating of nickel.

LIGHTING LARGE ROOMS WITH PEDESTAL FITTINGS.

In this country the use of pedestal fittings to produce indirect lighting is not well known, though it has been effectively employed in a number of cases in the United States.

In the *Electrical World* the use of this system at the South Shore County Club in Chicago is described. In this club there are two garden foyers in which an attempt was made to simulate daylight

illumination. Each room measures 36 ft. by 72 ft. The high arched ceilings are tinted a pale blue and the light is all supplied from a 7 ft. pedestal which contains two 500-watt gas-filled tungsten lamps with silvered reflectors. The absence of harsh shadows and glare is stated to be an agreeable feature.

Another room measuring 435 ft. square is lighted in a similar manner from a 10 ft. central pedestal unit containing five 500-watt gas-filled tungsten lamps.

LIGHTING IN LONDON AND THE PROVINCES.

Arrangements have been made at Walsall, says *Municipal Engineering*, for about 200 additional gas lamps to be lighted in the streets. The matter has been under consideration for some time, and it is thought that the public will appreciate this concession in view of the great danger that has existed owing to the darkened state of the streets. The lights can be extinguished in case of emergency.

The same journal states that the Pontypridd (Wales) Urban District Council consider that the local lighting required improvement. At a recent meeting of the Gasworks Committee of the Council the Chairman suggested that they should follow the example of Carmarthenshire, and light more lamps and it was decided to apply for the removal of the restrictions.

We notice references to this matter in other journals. For example, *Electricity* recently summarised steps being taken to improve the lighting in Bath, Birmingham, and Worksop, the latter, it is stated, to be lighted "as in normal times!" On the other hand, at Brancaster, in Norfolk, it was reported that the only oil lamp in the village should, during the winter months, be turned on "half full," the estimated saving being 2s. 9d.!

The action of the Wellington Urban Council, the Chairman of which announced that arrangements had been made for several members to inspect several streets where the lights had been recently shaded, is mentioned with approval. Cases are on record in which lamps have been extinguished without inspection, where they might very well have been allowed to remain lighted, and *vice versa*.

The lighting conditions in many provincial towns certainly seem to call for more careful consideration, with a view to agreement on some general principles in war time lighting. In London the present arrangements might with advantage be carried out in a more uniform manner, while still complying with the requirements of the Commissioner of Police, acting on the advice of the Field-Marshal Commander-in-Chief of the Home Forces. In the Provinces the methods adopted in different towns seem to differ still more widely.

THE REFLECTING POWER OF TUNGSTEN AND ITS EFFECT ON LAMP-EFFICIENCY.

A recent investigation undertaken by W. W. Coblentz and W. B. Emerson, at the Bureau of Standards, describes some tests on the reflectivity of tungsten in the infra-red. The experiments were made on plane polished mirrors, the reflecting power of which was compared with that of silver by a new method involving the use of a total reflection prism. With pure tungsten there is a marked indentation at 0·8 μ and 1·3 μ, but the latter does not occur with the impure metal. The reflectivity of tungsten rises abruptly from 50 per cent. at 0·5 μ to 90 per cent at 2 μ beyond which the reflectivity gradually increases to about 96 per cent at 6 μ.

The bands of selective absorption at 0·8 μ and 1·3 μ render tungsten conspicuous as being the only pure metal thus far investigated, which has bands of selective reflection in the infra-red. This property is intimately associated with the high efficiency of the metal for the emission of light. If one could discover a metal characterised by almost complete suppression in infra-red reflection, the result would presumably be a great gain in luminous efficiency.

TOPICAL AND INDUSTRIAL SECTION.

[At the request of many of our readers we have extended the space devoted to this Section, and are open to receive for publication particulars of interesting installations, new developments in lamps, fixtures, and all kinds of apparatus connected with illumination.

The contents of these pages, in which is included information supplied by the makers, will, it is hoped, serve as a guide to recent commercial developments, and we welcome the receipt of all *bona-fide* information relating thereto.]

B.T.-H. WIRING SUPPLIES.

WE have received a copy of a recent and well-prepared list from the Lamp & Wiring Supplies Dept. of the British Thomson-Houston Co., Ltd. This list, which extends to over 70 pages, relates entirely to wiring installation accessories, including wiring appliances, such as lampholders, switches, wall plugs, ceiling roses, cut-outs, distribution boards, fuse boxes, wood blocks, insulators, etc., etc.

This list is well adapted to the convenience of the buyer, being divided into five sections, each of which deals with a particular type of accessories. Each page is divided into two halves, the outer half being given to the illustrations and the inner half containing the listing and description of the devices. It has not been possible to include prices in this list, owing to the price fluctuations in this class of material under war conditions, but the B.T.-H. Co. issue regular quotations on this material each month.

There are several lines of accessories of particular interest in this new list, which we briefly refer to as follows:—

A new line of porcelain type Goliath Edison screw lampholders designed after careful study of the requirements of the Admiralty and other Government Departments.

Also new substantial designs of brass-cased Goliath holders. The quality of these holders will recommend them to all purchasers who desire a well-finished, substantial type of holder.

There are also listed excellent lines of standard bayonet and Edison screw holders, in both porcelain and brass case types.

Ceiling roses. Attention is particularly called to the well-known B.T.-H. "Quiklok" cover ceiling rose. This rose has been approved and standardised by the War Office, and has many points of advantage over the ordinary ceiling rose, the chief of which is that it can be wired on the bench and secured in position on the ceiling by a quarter turn of the wrist.

The well-known B.T.-H. interlocking switchplug is listed, in conjunction with numerous other types of combination switchplugs.

A line of new pattern distribution fuse boards is included, and a new range of insulators.

Copies of this list have been sent to all holders of the handbook issued by the L. & W.S. Department of the B.T.-H. Co. Extra copies can be obtained on application to the Company at Mazda House 77, Upper Thames Street, E.C.4.

STUDENT CAPTIVES.

We have received some further particulars of the work of the British Prisoners of War Book Scheme, which is under the direction of Mr. A. T. Davis of the Board of Education.

The booklet (No. 11) contains a letter of appreciation from the Prime Minister, and a general communication addressed to Mr. H. A. L. Fisher and signed by a large number of leading educationists and social workers expressing their sense of the great national value of this work. An introduction by Professor Gilbert Murray refers to the chief features of the scheme in fuller detail, and extracts from letters of captives at Ruhleben, Minden, Döberitz and other well-known camps testify to their gratitude for the educational matter received.

Under this scheme educational works can be forwarded to prisoners' camps, enabling them to carry on study in captivity, and thus alleviate the monotony and dreariness of their position. Readers can help by sending to Mr. A. T. Davis at the Victoria and Albert Museum, London, S.W.7, gifts of money or books. There could hardly be a better cause. The scheme should appeal with special force to scientific and technical men who can appreciate what a deprivation it must be to be cut off by captivity from all mental contact with the outside world.

"SUN NEWS"—A BULLETIN ON LIGHTING FROM JAPAN.

The Osaka Electric Lamp Co., in Japan, send us some specimen copies of a small illustrated booklet entitled *Sun News*, dealing with illumination. The text is entirely in Japanese, and the majority of the illustrations seem to refer to installations in Japanese cities. So far as one can judge most of these are carried out on lines familiar to Western nations. There are electric signs executed in Japanese characters, festoons of small lamps for lighting public gardens, and several instances of flood-lighting with batteries of searchlamps.

On the other hand we also notice an instance of special street lighting with glow lamps in typical Japanese lanterns, which follows more closely the traditional Eastern ideas on illumination.

INSTRUCTION IN ELECTRIC LIGHT SWITCHING.

Messrs. A. P. Lundberg and Sons send us a copy of a booklet, arranged by Mr. W. Perren Maycock and entitled *A First Course in Electric Light Switching and Testing*. The course is a simple preliminary one for junior technical classes and private students, and does not require elaborate tools or apparatus. It consists of a series of 17 exercises, accompanied by a list of apparatus required for 10—20 students. The author also provides some hints on working out electric circuit problems. It is hoped that the courses will be helpful to teachers of wiring classes, who are often restricted to a limited amount of material.

Assets exceed £2,500,000.

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F. NORIE-MILLER, J.P.
General Manager.

INDEX, November, 1917.

	PAGE
Artificial Lighting as an adjunct to Natural Illumination	290
Economy in Lighting in the United States	295
Editorial. L. Gaster	281
Flood-lighting for the Protection of Oilfields	292
Illuminating Engineering, A Year's Progress in	285
Illuminating Engineering Publicity by G. H. Stickney	289
Searchlights, Tests of	291
Short Notes on Illuminating Engineering—	
An Oxygen-filled Tungsten Lamp—Co-operation in Gas and Electricity Production—Gas Rationing in Holland—Outside Lighting of Cinema Halls by Gas—Classification of Illuminating Engineers for War Service—Lighting in London and the Provinces—The Reflectivity of Tungsten	293
Topical and Industrial Section—	
B.T.-H. Wiring Supplies—Student Captives—Instruction in Electric Light Switching—"Sun News": A Bulletin on Lighting from Japan—The Production of Ductile Tungsten—The Holophane Headlight	297

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This Coupon must not be cut out but left intact in The Illuminating Engineer as that being dated, forms the only evidence of its currency.

THE PRODUCTION OF DUCTILE TUNGSTEN.

We understand that in a recent account of Mr. Sydney Johnstone's lecture on "The Rarer Key Metals," to which reference was made in our last issue, it was stated that the manufacture of ductile tungsten for incandescent electric lamps was not carried on in this country before the war.

We are informed by the British Thomson-Houston Co., Ltd., that they were supplying their whole requirements of ductile tungsten for Mazda lamp filaments in 1912 by manufacture at their Rugby works. At that time, and until within a month or two from the date of the outbreak of war, the raw material used was tungsten oxide, but the Company, foreseeing a possible shortage of that material, immediately started the manufacture of the metal from the raw ore, which is of British origin. The whole process of refining the ore, and producing ductile tungsten filaments from the metal obtained, has now been continuously in operation since the middle of 1915, and it is stated that many millions of feet of wire have been made.

THE HOLOPHANE HEADLIGHT LENS.

In view of the discussion that has been taking place in the United States on the design of headlights, to which reference was made in our last number, it is of interest to mention a development in this direction, of which we have received particulars from Holophane Ltd. It is well known that State Laws and City Ordinances differ widely in their requirements. As an example we reproduce the requirements of the State of Connecticut, from whom the Holophane Lens Headlight has received an approving certificate. The legal requirements imposed are as follows:—

(1) "That no portion of the beam of reflected light, when measured 75 feet or more ahead of the lamps shall rise above 42″ from the level surface on which the vehicle stands."

(2) "Sufficient light to discern a person or substantial object 150 (250) feet directly ahead of the vehicle."

(3) "Sufficient side illumination to reveal any person, vehicle or substantial object 10 feet to both sides of a vehicle, at a point 10 feet ahead of lamps."

The Holophane device achieves these objects by a special division of the glass surface into specific areas, each having the appropriate specially designed prisms. The prisms in the upper portion serve to deflect and spread the top of the beam towards the horizontal; below this there is a diffusing projecting fin to prevent glare by shielding the filament; and below this a central area in which the lenses are shaped to illuminate the sides of the road and the road-surface near the car.

The third and lower part of the glass area consists of concentric prisms designed to spread the beam on the more distant parts of the road. The design of the projecting anti-glare fin, in particular, calls for special care.

The whole arrangement appears to offer an excellent example of the scientific control of rays of light and doubtless more will be heard of it when the present restrictions are somewhat relaxed.